

AMENDMENTS TO THE CLAIMS

1-24. (Canceled)

25. (New) A method of selectively creating chains for a virtual interface, the method comprising the computer-implemented steps of:
- determining whether a new encapsulation chain should be created, on a network element, for a particular virtual interface by determining whether at least one physical port of a particular card of the network element (a) is configured to send data packets of a type that would be produced by an encapsulation chain for the particular virtual interface and (b) can send data packets toward a destination associated with the particular virtual interface;
 - determining whether a new decapsulation chain should be created, on the network element, for the particular virtual interface by determining whether at least one physical port of a particular card of the network element is configured to receive data packets of a type that would be processed by a decapsulation chain for the particular virtual interface;
 - in response to determining that a new encapsulation chain should be created, on the network element, for the particular virtual interface, creating, on the network element, a new encapsulation chain for the particular virtual interface; and
 - in response to determining that a new decapsulation chain should be created, on the network element, for the particular virtual interface, creating, on the network element, a new decapsulation chain for the particular virtual interface.
26. (New) A method as recited in Claim 25, further comprising:
- in response to determining that a new encapsulation chain should not be created, on the network element, for the particular virtual interface, avoiding creating, on the network element, a new encapsulation chain for the particular virtual interface.
27. (New) A method as recited in Claim 25, further comprising:
- in response to determining that a new decapsulation chain should not be created, on the network element, for the particular virtual interface, avoiding creating, on

the network element, a new decapsulation chain for the particular virtual interface.

28. (New) A method as recited in Claim 25, further comprising:
in response to determining that a new encapsulation chain should not be created, on the network element, for the particular virtual interface, avoiding creating, on the network element, a new encapsulation chain for the particular virtual interface; and
in response to determining that a new decapsulation chain should not be created, on the network element, for the particular virtual interface, avoiding creating, on the network element, a new decapsulation chain for the particular virtual interface.
29. (New) A method as recited in Claim 25, wherein the step of determining whether a new encapsulation chain should be created further comprises the steps of:
in response to determining that no physical port of the particular card (a) is configured to send data packets of a type that would be produced by an encapsulation chain for the particular virtual interface and (b) can send data packets toward the destination associated with the particular virtual interface, then determining that a new encapsulation chain should not be created, on the network element, for the particular virtual interface.
30. (New) A method as recited in Claim 25, wherein the step of determining whether a new decapsulation chain should be created further comprises the steps of:
in response to determining that no physical port of the particular card is configured to receive data packets of a type that would be processed by a decapsulation chain for the particular virtual interface, then determining that a new decapsulation chain should not be created, on the network element, for the particular virtual interface.
31. (New) A method as recited in Claim 25, wherein the steps of determining whether a new encapsulation chain should be created and determining whether a new decapsulation chain should be created comprise the steps of:

determining whether a plurality of cards of the network element includes a specialized card that is designed to perform a type of data packet processing that would be performed by one or more chains for the particular virtual interface; and

in response to determining that the plurality of cards includes a specialized card that is designed to perform a type of data packet processing that would be performed by one or more chains for the particular virtual interface, then determining that a new encapsulation chain should not be created, on the network element, for the particular virtual interface and determining that a new decapsulation chain should not be created, on the network element, for the particular virtual interface.

32. (New) A method as recited in Claim 25, wherein the step of determining whether a new encapsulation chain should be created further comprises the steps of:
determining whether a plurality of cards of the network element includes a specialized card that is designed to perform a type of data packet processing that would be performed by one or more chains for the particular virtual interface; and
in response to determining that at least one physical port of the particular card (a) is configured to send data packets of a type that would be produced by an encapsulation chain for the particular virtual interface and (b) can send data packets toward the destination associated with the particular virtual interface, and the plurality of cards does not include any specialized card that is designed to perform a type of data packet processing that would be performed by one or more chains for the particular virtual interface, then determining that a new encapsulation chain should be created, on the network element, for the particular virtual interface.
33. (New) A method as recited in Claim 25, wherein the step of determining whether a new decapsulation chain should be created further comprises the steps of:
determining whether a plurality of cards of the network element includes a specialized card that is designed to perform a type of data packet processing

that would be performed by one or more chains for the particular virtual interface; and

in response to determining that at least one physical port of the particular card is configured to receive data packets of a type that would be processed by a decapsulation chain for the particular virtual interface, and the plurality of cards does not include any specialized card that is designed to perform a type of data packet processing that would be performed by one or more chains for the particular virtual interface, then determining that a new decapsulation chain should be created, on the network element, for the particular virtual interface.

34. (New) A method as recited in Claim 25, wherein determining whether a new encapsulation chain should be created and determining whether a new decapsulation chain should be created are based on user input.

35. (New) A method of selectively creating chains on a plurality of cards of a network router, the method comprising the computer-implemented steps of:

for each particular card within the plurality of cards, performing the steps of:

for each particular virtual interface of the particular card, performing the steps of:

determining whether at least one physical port of the particular card is configured to send data packets of a type that would be produced by an encapsulation chain for the particular virtual interface;

determining whether at least one physical port of the particular card is (a) configured to receive data packets of a type that would be processed by a decapsulation chain for the particular virtual interface and (b) can send data packets toward a destination associated with the particular virtual interface;

determining whether the plurality of cards includes a specialized card that is designed to perform a type of data packet processing

that would be performed by one or more chains for the particular virtual interface;

in response to determining that the plurality of cards includes a specialized card that is designed to perform a type of data packet processing that would be performed by one or more chains for the particular virtual interface, then using no resources of the particular card to create an encapsulation chain and a decapsulation chain for the particular virtual interface;

in response to determining that no physical port of the particular card is configured to send data packets of a type that would be produced by an encapsulation chain for the particular virtual interface, then using no resources of the particular card to create an encapsulation chain for the particular virtual interface;

in response to determining that no physical port of the particular card is configured to receive data packets of a type that would be processed by a decapsulation chain for the particular virtual interface, then using no resources of the particular card to create a decapsulation chain for the particular virtual interface;

in response to determining that at least one physical port of the particular card (a) is configured to send data packets of a type that would be produced by an encapsulation chain for the particular virtual interface and (b) can send data packets toward the destination associated with the particular virtual interface, and the plurality of cards does not include any specialized card that is designed to perform a type of data packet processing that would be performed by one or more chains for the particular virtual interface, then using resources of the particular card to create an encapsulation chain for the particular virtual interface; and

in response to determining that at least one physical port of the particular card is configured to receive data packets of a type that would be processed by a decapsulation chain for the particular virtual interface, and the plurality of cards does not include any specialized card that is designed to perform a type of data packet processing that would be performed by one or more chains for the particular virtual interface, then using resources of the particular card to create a decapsulation chain for the particular virtual interface.

36. (New) A volatile or non-volatile computer-readable medium carrying one or more sequences of instructions for selectively creating chains for a virtual interface, which instructions, when executed by one or more processors, cause the one or more processors to carry out:

determining whether a new encapsulation chain should be created, on a network

element, for a particular virtual interface by determining whether at least one physical port of a particular card of the network element (a) is configured to send data packets of a type that would be produced by an encapsulation chain for the particular virtual interface and (b) can send data packets toward a destination associated with the particular virtual interface;

determining whether a new decapsulation chain should be created, on the network

element, for the particular virtual interface by determining whether at least one physical port of a particular card of the network element is configured to receive data packets of a type that would be processed by a decapsulation chain for the particular virtual interface;

in response to determining that a new encapsulation chain should be created, on the network element, for the particular virtual interface, creating, on the network element, a new encapsulation chain for the particular virtual interface; and

in response to determining that a new decapsulation chain should be created, on the network element, for the particular virtual interface, creating, on the network element, a new decapsulation chain for the particular virtual interface.

37. (New) A volatile or non-volatile computer-readable medium as recited in Claim 36, wherein the one or more sequences of instructions further comprise instructions which, when executed, cause the one or more processor to carry out avoiding creating, on the network element, a new encapsulation chain for the particular virtual interface, in response to determining that a new encapsulation chain should not be created, on the network element, for the particular virtual interface.
38. (New) A volatile or non-volatile computer-readable medium as recited in Claim 36, wherein the one or more sequences of instructions further comprise instructions which, when executed, cause the one or more processor to carry out avoiding creating, on the network element, a new decapsulation chain for the particular virtual interface, in response to determining that a new decapsulation chain should not be created, on the network element, for the particular virtual interface.
39. (New) A volatile or non-volatile computer-readable medium as recited in Claim 36, wherein the one or more sequences of instructions further comprise instructions which, when executed, cause the one or more processor to carry out:
avoiding creating, on the network element, a new encapsulation chain for the particular virtual interface, in response to determining that a new encapsulation chain should not be created, on the network element, for the particular virtual interface; and
avoiding creating, on the network element, a new decapsulation chain for the particular virtual interface, in response to determining that a new decapsulation chain should not be created, on the network element, for the particular virtual interface.
40. (New) A volatile or non-volatile computer-readable medium as recited in Claim 36, wherein the one or more sequences of instructions further comprise instructions which, when executed, cause the one or more processor to carry out:
in response to determining that no physical port of the particular card (a) is configured to send data packets of a type that would be produced by an encapsulation chain for the particular virtual interface and (b) can send data

packets toward the destination associated with the particular virtual interface, then determining that a new encapsulation chain should not be created, on the network element, for the particular virtual interface.

41. (New) A volatile or non-volatile computer-readable medium as recited in Claim 36, wherein the one or more sequences of instructions further comprise instructions which, when executed, cause the one or more processor to carry out:
in response to determining that no physical port of the particular card is configured to receive data packets of a type that would be processed by a decapsulation chain for the particular virtual interface, then determining that a new decapsulation chain should not be created, on the network element, for the particular virtual interface.
42. (New) A volatile or non-volatile computer-readable medium as recited in Claim 36, wherein the one or more sequences of instructions further comprise instructions which, when executed, cause the one or more processor to carry out:
determining whether a plurality of cards of the network element includes a specialized card that is designed to perform a type of data packet processing that would be performed by one or more chains for the particular virtual interface; and
in response to determining that the plurality of cards includes a specialized card that is designed to perform a type of data packet processing that would be performed by one or more chains for the particular virtual interface, then determining that a new encapsulation chain should not be created, on the network element, for the particular virtual interface and determining that a new decapsulation chain should not be created, on the network element, for the particular virtual interface.
43. (New) A volatile or non-volatile computer-readable medium as recited in Claim 36, wherein the one or more sequences of instructions further comprise instructions which, when executed, cause the one or more processor to carry out:
determining whether a plurality of cards of the network element includes a specialized card that is designed to perform a type of data packet processing

that would be performed by one or more chains for the particular virtual interface; and

in response to determining that at least one physical port of the particular card (a) is configured to send data packets of a type that would be produced by an encapsulation chain for the particular virtual interface and (b) can send data packets toward the destination associated with the particular virtual interface, and the plurality of cards does not include any specialized card that is designed to perform a type of data packet processing that would be performed by one or more chains for the particular virtual interface, then determining that a new encapsulation chain should be created, on the network element, for the particular virtual interface.

44. (New) A volatile or non-volatile computer-readable medium as recited in Claim 36, wherein the step of the one or more sequences of instructions further comprise instructions which, when executed, cause the one or more processor to carry out: determining whether a plurality of cards of the network element includes a specialized card that is designed to perform a type of data packet processing that would be performed by one or more chains for the particular virtual interface; and

in response to determining that at least one physical port of the particular card is configured to receive data packets of a type that would be processed by a decapsulation chain for the particular virtual interface, and the plurality of cards does not include any specialized card that is designed to perform a type of data packet processing that would be performed by one or more chains for the particular virtual interface, then determining that a new decapsulation chain should be created, on the network element, for the particular virtual interface.

45. (New) A volatile or non-volatile computer-readable medium as recited in Claim 36, wherein determining whether a new encapsulation chain should be created and determining whether a new decapsulation chain should be created are based on user input.

46. (New) An apparatus for selectively creating chains for a virtual interface, comprising:
means for determining whether a new encapsulation chain should be created, on a network element, for a particular virtual interface;
wherein the means for determining whether a new encapsulation chain should be created comprises means for determining whether at least one physical port of a particular card of the network element (a) is configured to send data packets of a type that would be produced by an encapsulation chain for the particular virtual interface and (b) can send data packets toward a destination associated with the particular virtual interface;
means for determining whether a new decapsulation chain should be created, on the network element, for the particular virtual interface;
wherein the means for determining whether a new decapsulation chain should be created comprises means for determining whether at least one physical port of a particular card of the network element is configured to receive data packets of a type that would be processed by a decapsulation chain for the particular virtual interface;
means for creating, on the network element, a new encapsulation chain for the particular virtual interface, in response to determining that a new encapsulation chain should be created, on the network element, for the particular virtual interface; and
means for creating, on the network element, a new decapsulation chain for the particular virtual interface, in response to determining that a new decapsulation chain should be created, on the network element, for the particular virtual interface.
47. (New) An apparatus for selectively creating chains for a virtual interface, comprising:
a network interface that is coupled to a data network for receiving one or more packet flows therefrom;
a processor;

one or more stored sequences of instructions which, when executed by the processor, cause the processor to carry out:

determining whether a new encapsulation chain should be created, on a network element, for a particular virtual interface by determining whether at least one physical port of a particular card of the network element (a) is configured to send data packets of a type that would be produced by an encapsulation chain for the particular virtual interface and (b) can send data packets toward a destination associated with the particular virtual interface;

determining whether a new decapsulation chain should be created, on the network element, for the particular virtual interface by determining whether at least one physical port of a particular card of the network element is configured to receive data packets of a type that would be processed by a decapsulation chain for the particular virtual interface;

in response to determining that a new encapsulation chain should be created, on the network element, for the particular virtual interface, creating, on the network element, a new encapsulation chain for the particular virtual interface; and

in response to determining that a new decapsulation chain should be created, on the network element, for the particular virtual interface, creating, on the network element, a new decapsulation chain for the particular virtual interface.

48. (New) An apparatus as recited in Claim 47, wherein the one or more sequences of instructions further comprise instructions which, when executed, cause the one or more processor to carry out avoiding creating, on the network element, a new encapsulation chain for the particular virtual interface, in response to determining that a new encapsulation chain should not be created, on the network element, for the particular virtual interface.
49. (New) An apparatus as recited in Claim 47, wherein the one or more sequences of instructions further comprise instructions which, when executed, cause the one or more processor to carry out avoiding creating, on the network element, a new decapsulation chain for the particular virtual interface, in response to determining that

a new decapsulation chain should not be created, on the network element, for the particular virtual interface.

50. (New) An apparatus as recited in Claim 47, wherein the one or more sequences of instructions further comprise instructions which, when executed, cause the one or more processor to carry out:
- avoiding creating, on the network element, a new encapsulation chain for the particular virtual interface, in response to determining that a new encapsulation chain should not be created, on the network element, for the particular virtual interface; and
 - avoiding creating, on the network element, a new decapsulation chain for the particular virtual interface, in response to determining that a new decapsulation chain should not be created, on the network element, for the particular virtual interface.
51. (New) An apparatus as recited in Claim 47, wherein the one or more sequences of instructions further comprise instructions which, when executed, cause the one or more processor to carry out:
- in response to determining that no physical port of the particular card (a) is configured to send data packets of a type that would be produced by an encapsulation chain for the particular virtual interface and (b) can send data packets toward the destination associated with the particular virtual interface, then determining that a new encapsulation chain should not be created, on the network element, for the particular virtual interface.
52. (New) An apparatus as recited in Claim 47, wherein the one or more sequences of instructions further comprise instructions which, when executed, cause the one or more processor to carry out:
- in response to determining that no physical port of the particular card is configured to receive data packets of a type that would be processed by a decapsulation chain for the particular virtual interface, then determining that a new decapsulation chain should not be created, on the network element, for the particular virtual interface.

53. (New) An apparatus as recited in Claim 47, wherein the one or more sequences of instructions further comprise instructions which, when executed, cause the one or more processor to carry out:
determining whether a plurality of cards of the network element includes a
specialized card that is designed to perform a type of data packet processing that would be performed by one or more chains for the particular virtual interface; and
in response to determining that the plurality of cards includes a specialized card that is designed to perform a type of data packet processing that would be performed by one or more chains for the particular virtual interface, then determining that a new encapsulation chain should not be created, on the network element, for the particular virtual interface and determining that a new decapsulation chain should not be created, on the network element, for the particular virtual interface.
54. (New) An apparatus as recited in Claim 47, wherein the one or more sequences of instructions further comprise instructions which, when executed, cause the one or more processor to carry out:
determining whether a plurality of cards of the network element includes a
specialized card that is designed to perform a type of data packet processing that would be performed by one or more chains for the particular virtual interface; and
in response to determining that at least one physical port of the particular card (a) is configured to send data packets of a type that would be produced by an encapsulation chain for the particular virtual interface and (b) can send data packets toward the destination associated with the particular virtual interface, and the plurality of cards does not include any specialized card that is designed to perform a type of data packet processing that would be performed by one or more chains for the particular virtual interface, then determining that a new encapsulation chain should be created, on the network element, for the particular virtual interface.

55. (New) An apparatus as recited in Claim 47, wherein the one or more sequences of instructions further comprise instructions which, when executed, cause the one or more processor to carry out:
determining whether a plurality of cards of the network element includes a
specialized card that is designed to perform a type of data packet processing that would be performed by one or more chains for the particular virtual interface; and
in response to determining that at least one physical port of the particular card is configured to receive data packets of a type that would be processed by a decapsulation chain for the particular virtual interface, and the plurality of cards does not include any specialized card that is designed to perform a type of data packet processing that would be performed by one or more chains for the particular virtual interface, then determining that a new decapsulation chain should be created, on the network element, for the particular virtual interface.
56. (New) An apparatus as recited in Claim 47, wherein determining whether a new encapsulation chain should be created and determining whether a new decapsulation chain should be created are based on user input.
57. (New) A method of selectively creating chains on a plurality of cards of a network router, the method comprising the computer-implemented steps of:
for each particular card within the plurality of cards, performing the steps of:
for each particular virtual interface of the particular card, performing the steps of:
of:
determining whether at least one physical port of the particular card is configured to send data packets of a type that would be produced by an encapsulation chain for the particular virtual interface;
determining whether at least one physical port of the particular card is
(a) configured to receive data packets of a type that would be processed by a decapsulation chain for the particular virtual

interface and (b) can send data packets toward a destination associated with the particular virtual interface;

determining whether the plurality of cards includes a specialized card that is designed to perform a type of data packet processing that would be performed by one or more chains for the particular virtual interface;

in response to determining that the plurality of cards includes a specialized card that is designed to perform a type of data packet processing that would be performed by one or more chains for the particular virtual interface, then using no resources of the particular card to create an encapsulation chain and a decapsulation chain for the particular virtual interface;

in response to determining that no physical port of the particular card is configured to send data packets of a type that would be produced by an encapsulation chain for the particular virtual interface, then using no resources of the particular card to create an encapsulation chain for the particular virtual interface;

in response to determining that no physical port of the particular card is configured to receive data packets of a type that would be processed by a decapsulation chain for the particular virtual interface, then using no resources of the particular card to create a decapsulation chain for the particular virtual interface;

in response to determining that at least one physical port of the particular card (a) is configured to send data packets of a type that would be produced by an encapsulation chain for the particular virtual interface and (b) can send data packets toward the destination associated with the particular virtual interface, and the plurality of cards does not include any specialized card that is designed to perform a type of data packet processing that would be performed by one or more chains for the

particular virtual interface, then using resources of the particular card to create an encapsulation chain for the particular virtual interface; and

in response to determining that at least one physical port of the particular card is configured to receive data packets of a type that would be processed by a decapsulation chain for the particular virtual interface, and the plurality of cards does not include any specialized card that is designed to perform a type of data packet processing that would be performed by one or more chains for the particular virtual interface, then using resources of the particular card to create a decapsulation chain for the particular virtual interface.